SYSTEM AND METHOD FOR PROVISIONING DEVICE MANAGEMENT TREE PARAMETERS OVER A CLIENT PROVISIONING PROTOCOL

FIELD OF THE INVENTION

[0001] The present invention relates generally to the field of systems and methods for managing mobile electronic devices from a remote location. More particularly, the present invention relates to a system and method for updating applications and files of a client device via a wireless communication network.

BACKGROUND OF THE INVENTION

[0002] Computing devices may have different capabilities and features based on the applications installed in their memory. The applications may be pre-installed to a computing device before purchase by a customer or installed after purchase by a customer or service technician via a storage media, such as a magnetic or optical disk. For computing devices that communicate with a computer network, applications may be installed after a customer or service technician downloads the applications to the computing device.

[0003] Installations of applications and updates on client devices present other issues that are not a concern for wired devices. Users of client devices frequently need access to a variety of information, but such information is not as readily available as wired connections due to the limited bandwidth of wireless connections. Also, the traffic experienced by a client device should be minimized in order to minimize power drain on the device's power source. Thus, communications are challenged to

maximize the quality of information provided to client devices while minimizing the traffic imposed on the wireless connections to the devices.

[0004] A communication that utilizes a large number of applications must have the capability of managing the applications efficiently and proficiently. Two of the more important functions of these systems are client provisioning and device management. Generally, these functions operate independently (with the exception of the WAP profile used in SyncML device management bootstrapping). On the other hand, there are advantages for client provisioning and device management to converge. As application data protocols, both functions are typically generic and, thus, they are quite similar. The major difference between client provisioning and device management is at the level of transport protocols, where client provisioning is confined to a certain type. Thus, the amount and complexity of data that can be provisioned is limited. Accordingly, there is need for a system and method for converging and managing client provisioning and device management to provide significant benefit to communication service providers. There is further need for a system and method that would provide communication service providers with the ability to perform provisioning while in-call and without opening a data connection.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] FIG. 1 is a schematic view illustrating an embodiment of a communication system in accordance with the present invention.

[0006] FIG. 2 is a schematic view illustrating another embodiment of the communication system in accordance with the present invention.

[0007] FIG. 3 is a block diagram illustrating exemplary internal components of various servers, controllers and devices that may utilize the present invention.

[0008] FIG. 4 is a flow diagram representing an exemplary operation of a client device in accordance with the present invention.

[0009] FIG. 5 is a code diagram illustrating an exemplary data format that may be processed by the client device in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] Client provisioning and device management functions may be combined by defining client provisioning characteristics and parameters that would operate over a device management tree (DMT). For example, Open Mobile Alliance Client Provisioning (OMA CP) characteristics and parameters may be mapped to a DMT to create a new characteristic, namely synchronized markup language-device management (SYNCML-DM), which is recursive. Thus, communication service providers may have a generic and simple parameter provisioning mechanism using existing communication infrastructure. The mechanism would enable the communication service provider to perform provisioning while a user of a client device is communicating with a customer care representative of the communication service provider. The customer care representative would be able to address the user's problems efficiently and provide maximum satisfaction of user experience to the user.

[0011] One aspect of the present invention is a method for a client device of a communication system. The client device receives a client provisioning document from a source. The client device then identifies a device management characteristic from the client provisioning document. Thereafter, the client device stores data based on the device management characteristic of the client provisioning document to a device management tree.

[0012] Another aspect of the present invention is a client device of a communication system comprising a provisioning and management framework. The framework

receives a client provisioning document from a source, and the client provisioning document includes a device management characteristic.

[0013] Referring to Fig. 1, there is provided a schematic view illustrating a first embodiment 100 of a communication system. The first embodiment 100 includes a client device 102 communicating with a wireless communication network 104 through a wireless link 106. Any type of wireless link 106 may be utilized for the present invention, but it is to be understood that a high speed wireless data connection is preferred. For example, the wireless communication network 104 may communicate with a plurality of client devices, including the client device 102, via a cellular-based communication infrastructure that utilizes a cellular-based communication protocols such as Advanced Mobile Phone System (AMPS), Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), Global System For Mobile Communications (GSM), Integrated Digital Enhanced Network (iDEN), General Packet Radio Service (GPRS), Enhanced Data for GSM Evolution (EDGE), Universal Mobile Telecommunications System (UMTS), Wideband Code Division Multiple Access (WCDMA) and their variants. The wireless communication network 104 may also communicate with the plurality of client devices via a peer-to-peer or ad hoc system utilizing appropriate communication protocols such as Bluetooth, IEEE 802.11, IEEE 802.16, and the like.

[0014] The wireless communication network 104 may include a variety of components for proper operation and communication with the client device 102. For example, for the cellular-based communication infrastructure shown in FIG. 1, the wireless communication network 104 includes at least one base station 108 and a

server 110. Although a variety of components may be coupled between one or more base stations 108 and the server 110, the base station and server shown in FIG. 1 is connected by a single wired line 112 to simplify this example.

[0015] The server 110 is capable of providing services requested by the client device 102. For example, a user of the device 102 may send a request for assistance, in the form of a data signal (such as text messaging), to the wireless communication network 104, which directs the data signal to the server 110. In response, the server 110 may interrogate the device and/or network state and identify one or more solutions. For those solutions that require change or correction of a programmable module of the device 102, the server 110 may send update data to the device via the wireless link 106 so that the programmable module may be updated to fulfill the request. If multiple solutions are available, then the server 110 may send these options to the device 102 and await a response from the device before proceeding.

[0016] The first embodiment 100 may also include an operator terminal 114, managed by a service person 116, which controls the server 110 and communicates with the device 102 through the server. When the server 110 receives the request for assistance, the service person may interrogate the device and/or network state to identify solution(s) and/or select the best solution if multiple solutions are available. The service person 116 may also correspond with the device 102 via data signals (such as text messaging) to explain any issues, solutions and/or other issues that may be of interest the user of the device.

[0017] The first embodiment 100 may further include a voice client device 118 connected to the rest of the wireless communication network 104 via a wired or wireless connection, such as wired line 118, and is available for use by the service person 116. The voice client device 118 may also connect to the network via the server 110 or the operator terminal 114. Thus, in reference to the above examples, a user of the device 102 may send a request for assistance, in the form of a voice signal, to the wireless communication network 106, which directs the data signal to the server 110. While the server 110 and or the service person 116 is interrogating the device and/or network state, identifying one or more solutions, and/or selecting an appropriate solution, the service person may correspond with the device 102 via voice signals to explain any issues, solutions and/or other issues that may be of interest the user of the device.

[0018] Referring to FIG. 2, there is provided a schematic view illustrating a second embodiment 200 of the communication system. For this system, client provisioning and device management are converged. An example of client provisioning is OMA CP, and an example of device management is SyncML DM. As application data protocols, they are similarly generic, though device management tends to have a meta-data model that is missing from client provisioning.

[0019] The major difference comes at the level of transport protocols. For the example shown in FIG. 2, the OMA CP is confined to Wireless Application Protocol Push (WAP Push), which may limit the amount and complexity of data that may be provisioned. On the other hand, the ability to perform provisioning while in-call, and without opening a data connection, may be a significant benefit for the

communication service provider. The present invention is not limited to the embodiments shown. For example, SyncML DM binding over short message service (SMS) may be implemented. Preferably, to minimize additional cost, the device management may be implemented on existing infrastructure commonly used by communication service providers, such as OMA CP.

[0020] The client provisioning characteristics and parameters may be defined so that they may operate over the device management tree. A single new characteristic which is recursive may be utilized and is referenced herein as SYNCML-DM. The parameter names include, but are not limited to, a uniform resource identifier (URI) parameter, an operational (OP) parameter and a DATA parameter. The URI parameter is a sync node device management URI. An actual URI may be calculated as concatenation of URI's of nested characteristics and is the only parameter appearing in non-inner-most characteristics. The OP parameter is a node operation, with possible values such as ADD, REPLACE, DELETE and EXECUTE. The DATA parameter is data that may be applied by the operation, if any.

[0021] As shown in FIG. 2, the second embodiment 200 includes components at the network 104 and components at one or more client devices 102. Each component may be a separate device, controller or server, or two or more components may be combined within the same device, controller or server. The components at the network 104 include a device management server 202, such as a SyncML DM server, and a client provisioning server 204, such as an OMA CP server. The components at the client device 102 include a provisioning and management framework 206, which includes a device management agent 208 and a client provisioning agent 210. For one

embodiment, the device management agent 208 and the client provisioning agent 210 are managed by a parameter management frame of the provisioning and management framework 206.

[0022] The device management server 202 of the network 104 communicates with the device management agent 208 of the client device via communication link 212. For one embodiment, the signal protocol between the servers 202, 204 and the agents 208, 210 is a Hyper Text Transfer Protocol/Open Business Engine (HTTP/OBE). The Open Business Engine is an open source workflow engine written in JAVA, and OBE workflow definitions are written in XML and are typically executed by a J2EE container. The provisioning and management framework 206 also receives sync signals, in the form of WAP Push, from the device management server 202 via connection link 214 and provides the incoming device management signals to the device management agent 208 via connection link 218. Likewise, the provisioning and management framework 206 further receives provisioning signals, in the form of WAP Push, from the client provisioning server 204 via connection link 216 and provide the incoming provisioning signals to the client provisioning agent 210 via connection link 220.

[0023] The client device further includes a device management engine 222 communicating with the device management agent 208 via connection link 224 and a device management tree 226 communicating with the device management engine via communication link 228.

[0024] Referring to FIG. 3, there is provided a block diagram illustrating exemplary internal components of various servers, controllers and devices that may utilize the present invention, such as the client device 102 and the server 110 of FIG. 1. The exemplary embodiment includes one or more transceivers 302, a processor 304, a memory portion 306, one or more output devices 308, and one or more input devices 310. Each embodiment may include a user interface that comprises at least one input device 310 and may include one or more output devices 308. Each transceiver 302 may be a wired transceiver, such as an Ethernet connection, or a wireless connection such as an RF transceiver. The internal components 300 may further include a component interface 312 to provide a direct connection to auxiliary components or accessories for additional or enhanced functionality. The internal components 300 preferably include a power supply 314, such as a battery, for providing power to the other internal components while enabling the server, controller and/or device to be portable.

[0025] Referring to the client device 102 and the server 110 of FIG. 1, each machine may have a different set of internal components. Each server 110 may include a transceiver 302, a processor 304, a memory 306 and a power supply 314 but may optionally include the other internal components 300 shown in FIG. 2. The memory 306 of the servers 110 should include high capacity storage in order to handle large volumes of media content. Each client device 102 must include a transceiver 302, a processor 304, a memory 306, one or more output devices 308, one or more input devices 310 and a power supply 314. Due to the mobile nature of the client device 102, the transceiver 302 should be wireless and the power supply should be portable,

such as a battery. The component interface 312 is an optional component of the client device 102.

[0026] The input and output devices 308, 310 of the internal components 300 may include a variety of visual, audio and/or mechanical outputs. For example, the output device(s) 308 may include a visual output device 316 such as a liquid crystal display and light emitting diode indicator, an audio output device 318 such as a speaker, alarm and/or buzzer, and/or a mechanical output device 320 such as a vibrating mechanism. Likewise, by example, the input devices 310 may include a visual input device 322 such as an optical sensor (for example, a camera), an audio input device 324 such as a microphone, and a mechanical input device 326 such as a flip sensor, keyboard, keypad, selection button, touch pad, touch screen, capacitive sensor, motion sensor, and switch.

[0027] The internal components 300 may include a location circuit 328. Examples of the location circuit 328 include, but are not limited to, a Global Positioning System (GPS) receiver, a triangulation receiver, an accelerometer, a gyroscope, or any other information collecting device that may identify a current location of the device.

[0028] The memory portion 306 of the internal components 300 may be used by the processor 304 to store and retrieve data. The data that may be stored by the memory portion 306 include, but is not limited to, operating systems, applications, and data. Each operating system includes executable code that controls basic functions of the client device, such as interaction among the components of the internal components 300, communication with external devices via the transceiver 302 and/or the

component interface 312, and storage and retrieval of applications and data to and from the memory portion 306. Each application includes executable code utilizes an operating system to provide more specific functionality for the client device, such as file system service and handling of protected and unprotected data stored in the memory portion 306. Data is non-executable code or information that may be referenced and/or manipulated by an operating system or application for performing functions of the client device.

[0029] The processor 304 may perform various operations to store, manipulate and retrieve information in the memory portion 306. Each component of the internal components 300 is not limited to a single component but represents functions that may be performed by a single component or multiple cooperative components, such as a central processing unit operating in conjunction with a digital signal processor and one or more input/output processors. Likewise, two or more components of the internal components 300 may be combined or integrated so long as the functions of these components may be performed by the client device.

[0030] Referring to FIG. 4, there is provided a flow diagram representing an exemplary operation 400 of a client device. The exemplary operation 400 begins at step 402. Next, the client device receives a client provisioning document, such as an OMA CP document, from a source 406, such as the OMA CP server 204, and reads the client provisioning document at step 404. The client device then identifies a characteristic from the client provisioning document at step 408.

[0031] After identifying a characteristic at step 408, the client device determines whether the characteristic includes a URI parameter but does not include an OP parameter or a DATA parameter at step 410. If the characteristic only includes a URI parameter, then the client device appends the URI parameter at step 412, stores the URI parameter by pushing it down on a URI stack at step 414, and returns to step 408 where the client device identifies the next characteristic from the client provisioning document.

[0032] If the client device determines that the characteristic does not only include a URI parameter at step 410, then the client device determines whether the characteristic includes an OP parameter at step 416. If not, then the client device sets the OP parameter to "REPLACE" at step 418 and thereafter determines whether the characteristic includes a DATA parameter step 420. If the characteristic does include an OP parameter, then the client device proceeds directly to step 420 without updating the OP parameter.

[0033] The client device determines whether the characteristic includes a DATA parameter at step 420. If not, then the client device sets the DATA parameter to a NULL value at step 422 and sets device management tree (DMT) data at step 424. If the characteristic does include a DATA parameter, then the client device proceeds directly to step 424 to set the DMT data. To set the DMT data at step 424, the client device provides the data to the device management tree 226 (shown in FIG. 2). Thereafter, the client device returns to step 408 where the client device identifies the next characteristic from the client provisioning document. The exemplary operation

continues until all characteristics of the client provisioning document have been reviewed.

[0034] Referring to FIG. 5, there is provided a code diagram illustrating an exemplary data format 500 that may be processed by the client device. It is to be understood that FIG. 5 merely represents an example of the type of data format that may be utilized by the embodiments shown and described herein, and the type of data format is not limited to the one shown in FIG. 5. FIG. 5 shows an example of package setting log parameters which may be encoded in accordance with the present invention. The first line 502 of the exemplary data format 500 identifies the characteristic type of a first node to be SYNCML-DM. The second line 504 of the exemplary data format 500 sets the URI parameter of the first node to be "./DevDetail/Ext/Conf/Log".

[0035] The third line 506 of the exemplary data format 500 identifies a second node, nested within the first node, having a characteristic type of SYNCML-DM. The fourth line 508 sets the URI parameter of the second node to be "FileName", the fifth line 510 sets the OP parameter of the second node to be "REPLACE", and the sixth line 512 sets the DATA parameter of the second node to be "log.txt". The seventh line 514 refers back to line 506 and indicates the end of all descriptions of the second node.

[0036] The eighth line 516 of the exemplary data format 500 identifies a third node, nested within the first node along with the second node, having a characteristic type of SYNCML-DM. The ninth line 518 sets the URI parameter of the third node to be "Level", the tenth line 520 sets the OP parameter of the third node to be "REPLACE",

and the eleventh line 522 sets the DATA parameter of the second node to be "3". The twelfth line 524 refers back to line 516 and indicates the end of all descriptions of the third node. Likewise, the thirteenth line 526 refers back to line 502 and indicates the end of all descriptions of the first node and its nested sub-nodes.

[0037] While the preferred embodiments of the invention have been illustrated and described, it is to be understood that the invention is not so limited. Numerous modifications, changes, variations, substitutions and equivalents will occur to those skilled in the art without departing from the spirit and scope of the present invention as defined by the appended claims.